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THE CHALLENGES AND PROSPECTS OF DYNAMIC ELECTRONIC SERVICE IN STRENGTHENING DEMAND RESPONSIVE TRANSPORTATION SYSTEM IN ADDIS ABABA, ETHIOPIA

Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Master's Degree in Public Management and Policy

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Addis Ababa, Ethiopia

DECLARATION

I Dagmawit Moges, declare that this Master's thesis, entitled "The Challenges And Prospects of Dynamic Electronic Service in Strengthening Demand Responsive Transportation System in Addis Ababa, Ethiopia" is my original work submitted for the award of Master's Degree in Public Management and Policy at the Department of Public Administration and Development Management, College of Business and Economics, Addis Ababa University.

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The Role of Dynamic Electronic Service in Strengthening Demand Responsive Transportation System in Addis Ababa, Ethiopia

Approved by Board of Examiners

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Acronyms

AVL-Automatic Vehicle Location

C**CTV**-Closed-Circuit Television

DRTS - Demand Responsive Transportation System

GIS-Geographic Information Systems

GPS-Global Positioning System

ICT-Information Communication Technology

ITS- Intelligent Transportation Systems

IVRS-Interactive Voice Response System

LRT- Light Rail Transit

MeTEC- Metal and Engineering Corporation

PMT-Public Mass Transport

SMS-Short Message Service

TDC-Travel Dispatch Centre

USSD-Unstructured Supplementary Service Data

VMS- Virtual Memory System

Abstract

The aim of this paper is to investigate the role of Information Communication Technology (ICT) for the establishment and delivery of Demand Responsive Transportation Service (DRTS) in Addis Ababa city and to identify the major challenges of its implementation. Qualitative data was gathered through Key Informants Interviews. Additional data was also collected from relevant national and international documents. The collected data were analysed using qualitative data analysis and document review. Regarding the role of ICT for the establishment and delivery of DRTs, the results show that ICT Plays vital role to enhance advanced customers information system, traffic management, safety and security systems, signalization, automation of administrative and controlling functions, reliable electronic payment and provision of information about the transportation system to drivers and users.

However, there are major challenges associated with its implementation, which are poor telecommunication infrastructure, limited literacy on ICT science, high costs of ICT equipment, legal and regulatory issues, lack of organizational integrations, excessive reliance on foreign technology, poor understanding of the dynamics of the knowledge of electronic equipment. To tackle those challenges some policy options are suggested, building the capacity of the transport service management system, providing sufficient infrastructure, enhancing the cooperation of concerned government institutions, clearly stated policy and strategies, public-private partnership, awareness creation and training on ICT- based transport system, providing incentives and subsidy for technologies related to DRTS.

Keywords: DRTs, ICT, Public Service delivery

Chapter One

Introduction

1.1. Background of the study

Demand Responsive Transport (DRT) is a system operating without a fixed schedule, itineraries or stopping locations and operates solely when requested by customers (Errico, Crainic, Malucelli and Nonato, 2013). In the domain of public transport, the term responsiveness can also be used in the context of what sort of passengers are carried or how payment is organized (Brake and Nelson, 2007). The objective of DRT is to manage vehicle in an intelligent way, increase the efficiency of vehicle utilization by increasing the number of passengers in every vehicle, decrease the number of vehicles on streets and build vehicle`s routes in response to the customers` demand (Winter, 2015). Nevertheless, a major DRT problem consists of the balance between transportation demand on one side and a fleet of vehicles to serve this demand on the other side.

Since the end of the 1990s, the numbers of DRT systems have been increasing time after time in worldwide, with new investments in urban, suburban and rural spaces, and with varying degrees of operational flexibility. The flexibility and efficiency of DRT systems are predisposed by several factors, the most important being technological. Most of these technological developments are in the field of Information and Communication Technologies (ICT) (Clavel, Castex, and Josselin, 2008).

The type and level of ICT used are strongly reliant on the type of DRT service, its level of flexibility, and its specific optimization problem. Different practices show that technology can play a key role to optimize DRT trips and bring quality service to the population in a large area. Technology offers the potential for achieving real-time demand responsiveness in transport services, particularly in multifaceted networks, to a level far in advance of manual systems (Clavel et al, 2008).

Good public transport is vital to successful urban areas, enabling people to access jobs and services, employers to access labor markets and businesses to reach the customers for their services (IAPT, 2009). According to Tilahun (2014), the availability of safe public transportation can be considered as one of the things that can be easily secured in the developed world whereas tenuous

in most developing countries. Similarly, one of the striking characteristics of our time has been the rapid urbanization process in many developing countries (Hans, 2005). Such rapid growth naturally puts pressure on all city functions, not least transportation, which is the circulation system of the urban organism (ibid). One of the most pressing issues with transportation in the rapid urbanization is city congestion which affects the utilization of the limited space that is available to move around.

Generally, this makes movement in the city very challenging and it exerts a tremendous impact on the socio-economic activities of the country. Moreover, there is a loss of valuable time, which otherwise could be used in productive activities. Delays, uncertainty, and stress levels are also beginning to take their toll on both individuals and society (Abate, 2007). As a result, in most cities of Africa, authorities have had difficulty meeting the service demands for the new urban residents, particularly the poor, who are most dependent on public transport (Ajay and Fanny, 2008).

In the developmental state where government plays a significant role in socio-economic development, the level of its efficiency is vital not only for the citizens' wellbeing but also for the country's development in general. In a country like Ethiopia with a growing population, according to the central statistics agency, of 94,352,000 and Addis Ababa 3,300,000

(CSA, 2017) the issue of providing efficient transport system has a significant impact on citizens' service satisfaction and the economy as well.

As the nature of developmental states, there is a high expectation from the government concerning the provision of different services. Which, transport is not an exception. But there is a high level of inefficiency from the government side. Policymakers around the world have embraced e-government as the most likely tool to simplify the way governments operate (Mbabazi, 2014). E-government has indeed received a lot of attention and is defined differently by different sections of the academia and the international community depending on their intentions (ibid). Grant and Chau (2005) have noted that e-government has come to mean a lot of things to different people. Nonetheless, there remains a common theme that seems to run in all the definitions: e-government involves using information communications technology to improve the delivery of government services to citizens in an efficient and effective way.

Thus, this research was designed to assess the role of e-government in improving service delivery. Specifically, it looked into how ICT as a major component of e-service can be used to improve public transport service delivery by focusing on DRT in Ethiopia's capital, Addis Ababa. Based on this, the research assessed how ICT contributes to the establishment of demand responsive urban transport system which in turn will improve service provision. As urban transport provision is becoming one of the major challenges of our Country's urban centres and more specifically Addis Ababa, this research come up with a feasible recommendation.

1.2 Public transport in Ethiopia

Public transport in Ethiopia consists of operations to and from the capital Addis Ababa. The transport modal share in the Capital City Addis Ababa can be broadly spilled as many residents (54%) use walking as a main mode of transportation. For public transport, there are various public transport operators among which the dominant modes are city buses and mini-bus taxis. As per a recent inventory made by Addis Ababa City Transport Authority (as of January 2018), it is found out that there are 5,160 code-1 taxis, 11,688 code-3 mini-bus taxis, 505 Anbessa City Buses, 423 Sheger Buses, 125 Alliance Buses, 418 Higher midi-buses, 157 of 410 public service buses (dedicated to government employees) and 229 other modified Isuzu Buses which are giving public transport service to the residents of the city. In addition to that, the City Light Rail Transit (LRT) system also works as a means of transport into two directions with total capacity of 120 thousand passengers a day (Addis Ababa City Transport Authority, January 2018).

Due to the inadequacy of the supply and the absence of coordination, the supply cannot fulfil the transportation need of the city residents. As the vehicles, which are providing the service, are old, not comfortable and nor safe and their maintenance cost is high, there are many vehicles which are out of the service (ibid).

The large proportion of walking suggests that public transport fares are globally unaffordable for the level of income of the city population. Car ownership among residents is very low. According to Addis Ababa Transport Authority 2018 report it is, 574,636. So, majority of the residents depend on buses and taxis for their day-to-day mobility in terms of motorized transport. Until 1992, the right to operate large buses within Addis Ababa was exclusively held by Anbassa while minibus

‘taxi' services were restricted and regulated on a zonal basis by the public authority (Trans-Africa Consortium, 2008).

In 1992, the public transport market was deregulated by a transitional political regime through the ‘Proclamation to Provide for the Regulation of Road Transport' which limited the conditions for running a public transport activity to only two: proven roadworthiness of the vehicle and qualification of the driver. Once this permit was issued, the carrier was then able to operate throughout the city with no exclusion from routes or areas (ibid).

1.2.1 Public transport regulation

The public transport sector is supervised by the Ministry of Transport and Communications at the federal level, which has responsibility for formulating policy and issuing directives to give a clear vision of public transport development in the country. It acts through the Ethiopian Road Transport Authority which was established in 1967 and is responsible for the use of any roads within Ethiopia, the vehicles using these roads and for all road transport activities. At Addis Ababa City Government level, public transport and infrastructures are managed by the transport authority under the auspices of the City Government with the overall mandate to issue route licensing and permits to the operators. The fares are regulated by the City Government with a substantial difference between the minibuses and Anbassa, whose fares are subsidized (Trans-Africa Consortium, 2008).

1.2.2 Public and private transport operators

1.2.2.1 Anbessa City Bus Service Enterprise

Anbassa city bus service enterprise is a formal bus company created in 1963 as a private enterprise holding an exclusive franchise for the provision of passenger transport services in Addis Ababa, yet was nationalized in 1974. It came to be a public enterprise only after it was re-established in 1994. Currently, the enterprise is organized under the Addis Ababa City Government.

Now Anbessa operates a fleet of 460 (as of January 2018) conventional large buses, with an average vehicle age of seven years, and provides scheduled services along about 124 routes

accounting for about 10.8% of the public transport market share, that is 106 million passengers used annually (Addis Ababa City Transport Authority, January 2018).

Fares are controlled by the City Government which compensates with a subsidy per ticket sold. Anbessa faced financial difficulties and failed to provide transport, especially in the city outskirts, making the population more and more dependent on walking. Its structural difficulties resulted in a low level of fleet availability (Fenta, 2014).

But recently, Anbessa has begun to acquire buses assembled locally by the Metals & Engineering Corporation (MeTEC), which is an industrial complex of the Ethiopian government. The enterprise has included in its fleet more than 550 of these locally assembled buses known as Bishoftu Buses, which bear the town's name where the assembly plant is located. In addition, the city administration has recently procured 750 buses from MeTEC ranging from flat floor, mid-floor and double-decker and school buses. The tariffs for the new buses also changed as of December 2018 (Addis Ababa road and transport bureau, 2018).

1.2.2.2 Taxi

The City of Addis Ababa is also served by minibuses also known as "taxis". Basically, they are blue painted minibuses with a white roof - and are thus known as "blue donkeys" - with a seating arrangement of 12 seats. They travel very fast from one part of the city to another. The mini buses are mainly used by Addis Ababa residents to reach their workplace, and tend to represent a better quality of service than the conventional buses (Trans-Africa Consortium, 2008).

The common privately owned minibus taxies are the Toyota Jaguar, Haice, the Nissan minibus, and the Peugeot or another pick up vehicles, which are converted to taxis. According to the data from Addis Ababa City Transport authority, the number of minibus taxis is registered as about 5,561. They are serving about 563,472 passenger trips a day. Currently, there are about 375 routes operated by the white and blue mini-bus operators in the city. These routes are divided into 5 zones and there are about 13 operator unions operating these mini-buses in the city (Addis Ababa Road and Transport Bureau, 2018). When we come to the white minibuses they are a kind of supporters to alleviate the city transport problems. To that end, 11,688 white minibuses, signed an agreement

to work on the city 406 routes. 1,171,392 passengers 44.7% of the public transport share covered by this support giver code 3 minibus taxis (ibid)

Concerning the fares, in principle, it is controlled by the transport Authority though passengers confirm that the actual fares charged vary somewhat arbitrarily depending on circumstances such as congestion or bad weather. Inadequate vehicles, loading extra passengers and bad behaviour of taxi drivers and their assistants make this form of taxi transport difficult.

1.2.2.3 Light Rail Transit (LRT)

Light Rail Transit (LRT) being one of the latest modes of transport for Addis Ababa city residents, is giving service for 120,000 passengers per day. The number of locomotives involved so far is 31. LRT's contribution to the city transport is 4.5% of the total share of public transport (Addis Ababa road and transport bureau, 2018).

1.2.2.4 Mid buses

In 2008, the City government undertook to purchase 500 minibuses at a cost of about EUR 10 million through a bank loan and distributed them to private operators for a five year repayment period (Trans-Africa Consortium, 2008). But currently, they are finalizing the loan but they are facing many problems in relation to spare parts and others as per the report of Addis Ababa road and transport bureau, 2018. Despite all these challenges these mid buses are transporting 69,750 passengers per day. This covers 2.7% of the modal share.

Table 1: Performance of Transportation Systems in Addis Ababa City

No	Type of Public Transport	Performance			Passenger per day	Modal share in %
		Plan	Actual	%		
1	Anbessa	460	390	84	282,650	10.8
2	Sheger	265	241	91	219,310	8.4
3	Alliance	125	64	51.20	40,960	1.5
4	Public service	273	144	52.3	73,440	2.8
5	Code 1 (blue and white)	5,561	3,354	60.3	563,472	21.5
6	code 3 (support provider)	11,688	6,101	52.3	1,171,392	44.7
7	Haiger	418	155	37	69,750	2.7
8	Midibus (Isuzu modify)	376	182	48	81,900	3.1
Total		**19,166**	**10,631**		**2,502,874**	**95.5**
9	LRT	38	31		120,000	4.5
Total		**19,166**	**10,631**	**55.5**	**2,622,874**	**100**

Source: Addis Ababa City Transport Authority six month report (December, 2018)

1.2.3 The public transportation system in Addis Ababa City

Urban transport in Addis Ababa is carried by a mixture of ownership structures, of which public and private operators are predominantly contenders for business. The modes of the urban transport system in the Addis Ababa are categorized in to motorized and non- motorized traffic. As such the modes of transport include public bus; minibus; taxis and the non-motorized transport (Fenta, 2014). Currently, as indicated in the above table 1, public transport including Anbessa buses, Sheger, Public service, and LRT all together cover about 26.5%. While Alliance buses, Minibus taxis, Higher and others all together cover about 73.5% of modes of transport (Addis Ababa road and transport bureau, 2018).

The City Government developed the Addis Ababa Transport Plan which has a Public Mass Transport (PMT) System Development Component that includes the rejuvenation of Anbassa City Bus Enterprise, the introduction of medium capacity PMT Technology comprising Bus Rapid Transit /Light Rail Transit System along major corridors, and promotion of Minibus Taxi Services.

However, the existing public transportation system could not satisfy the demand. Moreover, the insufficient finance for investment by the government and the limited participation of the private sector in the service has also contributed to deficiency of transport supply in the city (Fenta, 2014). Therefore, in order to tackle the transportation service problems and to address the massive demand, there is a need to establish Demand Responsive Transportation Systems at every corner of the city.

1.3 Statement of the problem

Transport is the engine of social and economic activities. The provision of the competent and efficient transportation system is of paramount importance for the cities especially in the modern era of globalization and information age where cities are the centers of urbanization and propellers of national and global economies (Tesfaye, 2012).

In cities like Addis Ababa, whereby there are several resource constraints, the dwellers suffer from lack of efficient and effective transportation system. As a result of this, waiting time for any type of transportation system by the inhabitants is much longer than the expected time. On average, the waiting time for public transport in Addis Ababa is more than 40 minutes (Abate, 2007). Moreover, due to congestion as a result of the poorly managed traffic system, people spend unnecessary longer time on the bus or taxi, which is an additional waste of valuable time. Thus either resident had to wake up early or arrive at their workplace late, costing the economy more productive time (ibid).

The dilemma for policy maker in public transportation service provision lies on the choice between mass transportation to address the needs of the majority or to rely on any available means of transportation or adjust the system to demand responsive transport system to address the growing needs of the middle-income society (Ajay and Fanny, 2008). This depends on various factors such as availability of adequate infrastructure mainly major and feeding roads, ICT infrastructure, affordability and accessibility of the various types of transportation means, efficiency and effectiveness of each transportation means in addressing the demands of the majority and so on (ibid).

Up and coming cities, like Addis Ababa, are places of opportunities and growing urban challenges where the prioritization of appropriate transport technologies and infrastructure is crucial to respond to the growing challenges of rapid urbanization, high level of congestion, urban sprawl, climate change, and energy issues. Transport technology plays a major role in defining the urban form and determining the spatial arrangement of activities and hence the extents to which important destinations are accessible (Gebeyehu, 2008). The city of Addis Ababa is striving to address the pressing transport problems and growing urban challenges through the implementation of ICT and different telematics technologies.

Many cities managed to improve the public transportation system to demand responsive system by using ICT and systematically adjust the service provision to dynamic electronic service provision. Various studies also analyzed the utilization of ICT in the public transport system mainly in various developed countries (Ryley, 2014; Kisla, Tuba, and Yildiz, 2016; Enoch, 2005). Different studies have been conducted on Demands for Urban Public Transportation in Addis Ababa (Tilahun Meshesha & Fenta, 2014 and others). For instance, the study by Fenta (2014) concentrates on contemporary urban development and transport planning practices from the perspective of providing sustainable accessibility, complete street design, place making, compatibility to the public transport network and competency of new road infrastructure to current and future challenges of the city. Similarly, Abate (2007) analyzed the performance of the public transport system using some efficiency criterion in Addis Ababa. However, it has been said that the contribution of ICT and major implementation challenges are not yet fully understood and evaluated (Tesfaye, 2012). To the researcher's knowledge, the utilization of ICT in the urban public transport system in cities like Addis Ababa or developing countries remains largely under-addressed. As this is being a fact, absence of ICT resulted in inefficient service delivery from the government side which resulted in luck of quality service provision. From the users side, as they could not get up to date information they cannot manage their time in an efficient and effective manner. To this end, this study identifies those challenges which are affecting the successful implementations of ICT, especially in demand responsive transportation services. Therefore, the aim of this research was to assess the role of ICT (technologies) for the establishment of Demand Responsive Transportation Service in Addis Ababa and to investigate the major challenges of its implementation.

1.4 Objectives of the study

1.4.1 General objective

The major objective of this study is to analyze the role of ICT (technologies) for the establishment and delivery of Demand Responsive Transportation Service in Addis Ababa City.

1.4.2 Specific objectives

- To explain and analyze the types of Demand Responsive Transportation services that are currently available in Addis Ababa.
- To identify the effect of ICT in the establishment and delivery of Demand Responsive Transportation service in Addis Ababa.
- To identify the major challenges of the usage of ICT in Demand responsive transportation service in Addis Ababa.
- To forward possible policy recommendation

1.5 Research Questions

1. What are the types of Demand responsive transportation services that could be possibly introduced, in Addis Ababa' public transportation system?

2. What is the level of ICT utilization in public transportation service in Addis Ababa?

3. What are the major roles ICT can play to upgrade and deliver enhanced Demand Responsive Transportation service in Addis Ababa?

4. What are the major constraints of using an implementation of ICT (technologies) in Demand responsive transportation service in Addis Ababa?

1.6 Significance of the study

The problem of demand responsive to urban transport has hardly been studied sufficiently in Ethiopian urban centers. The focus of government officials, donor agencies and scholars has not been on demand responsive urban transport provision. More importantly, demand responsive urban transport problems are hardly discussed in the literature. Transport as a problem of urban areas has been discussed mainly from observed phenomena. Demand-based study of urban transport has been deeply examined neither in Ethiopia nor in Addis Ababa. Therefore, it is hoped that the results of this study will assist the government to identify the major challenges regarding the implementation of ICT in the transportation sector and to reformulate and adjust its policy accordingly. The results will also assist the private demand responsive transport service providers to have a better understanding of the area and to utilize the information as an input for their businesses. At last but not least, the findings from this study can assist academicians in broadening of the prospectus with respect to this study by providing a better understanding of the major constraints that affect the implementation of ICT in the transportation sector. Therefore, it is possible to conclude that this paper can shed some light on this timely issue.

1.7 Scope of the study

Since demand responsive transportation system is at its infant stage in Ethiopia, the study focused on the establishment stage of Demand Responsive transportation service. Although there are many aspects to study on the Demand Responsive transportation service, it is proved that ICT has a crucial role in the establishment of DRT service (Nelson and Romanazzo, 2004). Therefore the study tried to focus on the role of ICT to the strengthening and expansion of DRTS. Moreover, the study only concentrates on Addis Ababa public transportation system. Since the focus of the study is on demand responsive public transportation service, data is collected from the Private DRTS providers, public transportation services as a potential provider and respective government employees, managers and officials.

1.8 Delimitation of the study

Generally speaking, public transportation service in Ethiopia is very inadequate and suffers from various challenges. Thus, one of the delimiting factors that can affect this study is the lack of adequate data on the current public transport system and also the use of ICT. Moreover, finding individuals with the knowledge on demand responsive system, mainly in developing countries context was another challenge. Furthermore, the study is delimited to Addis Ababa City again due to time and financial constraint. However, since administration procedures are the same in the cities of the entire country, the result that is obtained taking the case of the city could reflect the need of other cities, under normal circumstances.

Chapter Two

Review of Related Literature

2.1. Introduction

This chapter discusses the major theories on the electronic public services and the characteristics of electronic public service which differentiate it from the private electronic services. The other focus areas of this chapter are Demand Driven Transportation services, their distinguishing characteristics, their performance, their role in the country's economy. The chapter also reviewed both conceptual and empirical pieces of literature related to the status of Public Transportation Services in developing countries. Finally, there is a theoretical framework which could be a basement for evaluating the role of dynamic electronic services to establish Demand Responsive Transportation System in the Addis Ababa city.

2.2. Basic Demand Responsive Transportation Concepts and Success/Risk Factors

There is a large spectrum of Demand Responsive Transport systems, from the most "rigid", operating almost as traditional regular transportation systems, to the most flexible, operating almost as taxis (Gomes, 2013). In fact, both extremes can be regarded as "special" types of DRT systems. Usually, more flexible systems are operated to satisfy special groups' needs (e.g., elderly or disabled) whereas less flexible solutions (without a door-to-door service) are operated for "general" users. DRT systems can also operate in different ways according to the geographic characteristics of a given service area (ibid). According to (Nelson 2004) the most important aspects of a DRT system are the service concepts – essentially route and time concepts; the booking concepts; the network concepts and the vehicle allocation concepts.

2.2.1. DRT Service concepts

The route of service is a list of stops that will be served in a specific order. The timetable indicates the passing times of the vehicle at a given stop. For a conventional scheduled service, these elements are fully defined in advance. For taxi service, for instance, none of these elements is defined in advance. Between these two extremes, a wide range of different concepts is possible,

even services where stops and passing times are determined during the service operation. The type of service is mainly defined by the flexibility of the route (Westerlund et al. 2000).

Nelson (2004) proposes a classification of route concepts for a generic DRT service with an increasing level of flexibility. These concepts are built up using the following types of stops: a fixed stop (like conventional bus stops) – a predefined stop with a predefined passing time and which is always served, a predefined stop with a predefined passing time which is only served on request, a predefined stop which is only served on request and a stop point anywhere in the region indicated by the address or the name of the place.

López (2010) also presents a possible classification of DRT services according to the type of stops: regular stop point's service; stop-to-door service; door-to-door service and hail-and-ride service, where the user physically signs its intention to use the service. An important aspect of a DRT service is the definition of 'passing time'. Normally time-windows are accepted on the requested time, to give some time flexibility thus allowing additional stops to be served.

Based on combinations of stops and passing time, (Nelson 2004) defines several route-service scenarios (codes are added for better reference throughout the present document): Predefined route and partially fixed timetable: deviations on a scheduled service to predefined routes: predefined stops in a corridor: predefined stops in an area and points in an area.

These basic DRT scenarios can be combined to best match the demand patterns. For instance, one can have a service based partially on a fixed route and stops in the city center, and an area-wide service on request in the suburbs. Another important aspect in terms of service is the type of users of the service: special groups and the general public. As already mentioned, usually, more flexible systems are operated to satisfy special groups' needs (elderly or disabled) whereas less flexible is operated for "general" commuters (Nelson, 2004).

2.2.2. DRT Network concept

DRT Services can have different roles in global public transport offer. (Nelson 2004) presents some possible roles. 1) Stand-alone DRT service: especially in rural environments, DRT services can be operated without any time or spatial relation with other services. For example, the opening hours of health services, or the location of the community can be the main elements for the

definition of the service. 2) DRT feeder service: the passengers use the DRT as a means to reach another transportation service. The main objective of such a feeder service is to complement a direct service between two important centers in order to avoid deviations in that direct service. 3) DRT with multiple service roles: combining the characteristics of the previous two roles, the DRT provides the inhabitants of a region, a transportation service to the most import nearby center where both services and travel interfaces are located. Therefore the DRT functions as a standalone and a feeder service. There is even the possibility of different roles according to different periods of the day of different areas (multitasking).

2.2.3. DRT Vehicle allocation concept

An important choice in the definition of the DRT service is the way vehicles are allocated to each service. 1) Fixed vehicle allocation: the DRT service is defined with only one vehicle available. The characteristics of this vehicle determine to a large extent the type of DRT service. 2) Extendable vehicle allocation: if the operator does not want to refuse passengers, the service can be defined starting from a given fixed number of homogeneous vehicles, but the use of extra vehicles can be considered within certain limits (for example, a co-operation with a taxi operator, to transport additional passengers that could not be picked up by the initial services). 3) Dynamic allocation of vehicles: the operator of the DRT service will ideally have a pool of available vehicles to be used for the service operation. Different types of vehicles (capacity, accessibility, special features) will form part of such a pool. Eventually, some of the vehicles can also be operated by other companies (Ambrosino et al, 2003).

2.3. The Concept of Electronic Service

Although e-government has been utilized in various service provision mainly in developed countries, having a clear understanding of the concept is vital in order to link the service with innovative technologies. Rowley (2006) linked the deeds, efforts or performance of service to information technology. That is, the delivery is mediated by the advancement of information technology. Such electronic service includes the service elements of e-tailing, customer support, and service delivery. This definition emphasizes that e-services are on situated of actions (deeds, efforts or performances) mediated by information technology. Another definition is offered by de Ruyter et al. (2001, p.186), who define an electronic service as "...an interactive, content-centered

and Internet-based customer service, driven by the customer and integrated with related organizational customer support processes and technologies with the goal of strengthening the customer-service provider relationship". In comparison to Rowley's (2006) definition, this definition is narrower and emphasizes that the e-service is internet-based, interactive, customer-driven, and integrated with related technologies and processes within the supplying organization.

According to Lindgren &Jansson (2013), there are three theoretical dimensions of public electronic services concepts. Those are the emergent perspective, the organizational imperative and the technological imperative. The emergent perspective focus on the relationship between information technology and organizational change, namely that the uses and consequences of information technology emerge unpredictably from complex social interactions. This perspective acknowledges that behaviors and consequences, of both humans and the environment, are difficult to predict a priori. The organizational imperative, in turn, assumes that behaviors are chosen according to a set of consistent preferences and that the impact of information technology on organizational change is a result of the motives and actions of the designers of information technology. This perspective assumes more or less unlimited control over both technological options and their consequences. On the other hand, the technological imperative views technology as a force that determines and constrains the behavior of individuals and organizations; in this perspective, information technology is seen as a cause of organizational change. Assuming the issues suggested by the above two views remains unchanged, this research chooses to focus and work on the third view due to the very rapid development of new technologies in the public service and to explore what roles these emerging electronic services can play to the establishment of demand responsive public services.

2.4. Electronic Public Service and its Characteristics

Public services are defined as the services provided by public organizations to citizens, both collectively and individually, either directly or by financing private providers (Christensen et. al., 2005). It is important to acknowledge that public sector organizations are not uniform; they vary in terms of function and structure, as well as according to administrative level (i.e. local, regional and state levels). However, on a general level, there are certain rudimentary characteristics that are shared by all public organizations (Lindgren &Jansson 2013).

Turning to the electronic government context, electronic public services deals with the conversion of manual based service provision to computerized system and in advanced context, it deals with re-inventing and innovating the whole public service provision. Thus, electronic public services typically deal with intangible goods such as exchange of information in order to receive permits, disbursements, register tax or similar. In fact, as some observers highlight, e-government represents the realization of an information-intense government. Consequently, e-services become a matter of managing information and the relationship between governments and citizens become an information-based relationship (Bekkers & Homburg, 2005; Taylor & Lips, 2008).

Public e-services usually do not involve the actual output, or end-product, of public policy, such as the teaching in schools or the medical treatment of a patient. Rather, public e-services can constitute the mediation of that service, the means through which this service is being communicated and accessed. In turn, by emphasizing the public prefix of public e-services, issues of availability and accessibility are placed in the foreground. When mediating public e-services, the constitutionally enshrined principles of equity and fairness in public services provision means promoting equal access. Public e-services have to be made available to different groups of citizens, with different needs. Public e-services thus become a matter of access to governments and governmental output, and hence, a matter of civil rights or protection of citizen obligations (Lindgren &Jansson, 2013).

2.5. The Role of Electronic Service for Public Service Delivery

Public services are everywhere and need to be reformed, re-invented, and modernized. The reason for this is that the state of public services and their proposed futures appear at the center of public and political debates (Newman, 2009). For instance, the quality of public service provision remains at the core of public and political reforms. That is why, many governments and public service organizations are trying to secure the fundamental changes in the governance and design of public service delivery (Ferlie, 2003). The changes mainly focus on public institutions is closely associated with the needs of society (CTFT, 2014).

There are several aspects to be considered when delivering better services to the public. In order to identify these, we need to put the society (user) in the position of consumer and citizen at the same time. Those aspects are (i) accountability between the providers and users and community;

(ii) representation and participation from the whole citizen body and users of the service through discussion and decision-making on policy and practice; (iii) information about the availability, operation, organization, and performance of the service related to the user's interest; (iv) access including availability, easiness, adaptability to meet the new needs; (v) choice to be freely made by the users; and (vi) redress through complaint channels and the related procedures (Deakin& Wright, 1990).

Public services are very crucial to building a good relationship and improve trust in society. It can, under some conditions, act as the focus of the formation of public imaginaries and collective identities, as well as help which sustains solidarity attachments (Newman, 2009). This is the main difference between public and private services. This is based on the fact that public services can deliver public needs which cannot be provided by private markets for all of population to take advantage of it.

The government must deliver public service with a set of innovations by giving attention to public needs (Stewart, 1987). It will encourage an effective role for the user to ensure good public service (Deakin& Wright, 1990). A better understanding could help in providing realistic promises to citizens and users of services, and contribute to building trust in public service organizations. The manner should go beyond simple automation and attempt to re-think the broader nature of government services (ibid)

In the past decade, ICTs (such as email, online chatting, server, etc.) were gradually introduced by governments to involve citizens and to distribute the latest news or updates (Holzer, 2015). It was introduced first in the early 1990s (Anthopoulos, 2015). But today, public services need more than ICTs. It needs the more complex practices of the e-government system.

E-government is used to improve the efficiency of government services delivery to citizens, employees, businesses, and agencies. It can improve communication between government agencies and their constituents by providing way in to information and services online at relatively low cost, and provide public services through websites (Chen, 2009). The combination of ICTs and citizen participation will create e-participation, enabling citizens to play a better role in government running (Holzer, 2015).

According to Brown, D. (2005) E-government has had a considerable impact on public administration, changing the environment in which the public service activates, adding new theories and methods to its operations and changing the relative weight and relationships among established elements of public administration. As with government as a whole, the changes are ongoing and it is difficult to predict where they will lead. This discussion, however, focuses on four areas where there have been clear and lasting impacts (ibid).

i. Citizen-centered service

Perhaps the single most powerful concept innate in e-government is client-centered service delivery. Borrowed from the private sector, and predating the internet, this concept has come into its own with the World Wide Web. In this view, government services should be planned from the starting point of meeting citizens' needs or of helping citizens to meet their civic obligations. The formal organization of government assumes secondary importance and instead different parts of government or even levels of government are brought together by their common relationship with identifiable communities within the larger population. In the electronic environment, citizen capacity is a factor as well as citizen need and public administration is pulled to present itself where the public is located, physically and online.

ii. Information as a public resource

The second characteristic of public administration in the e-government context is the emergence of information as a key resource of government, requiring its own legislation, policies, and institutions. While activities such as records management and documentation have always been an essential feature of government, it has only been with the development of e-government that the information assets of government have been understood to be as important as the financial and human resources that have been the traditional focus of public administration.

iii. New skills and relationships

The third characteristic of e-government is the role played by technology in shaping the environment in which public administration operates and the knowledge and skills required by public service managers and workers. For practical purposes, the public service workplace is one where there is a computer on every desktop and routine use is made of e-mail, word-processing

suites and the World Wide Web. This situation contrasts with the environment often or even fewer years ago, where the telephone and the post were primary working tools. The adoption of electronic technologies in government has been a remarkable story of organizational learning and adaptation that is still unfolding. The networking that is inherent in e-government has also given a new emphasis to working methodologies that emphasize group collaboration and information sharing, typically cutting across the vertical division of labor that is a characteristic of classic bureaucracy.

iv. Impact on accountability and management models

The fourth notable impact of e-government on public administration is on accountability and management models. The client-service orientation of e-government changes the relationships between the public, the civil service and elected representatives in practice and raises issues in principle. At the very least, the emphasis on providing service preferably good service to the public broadens the focus of civil servants from their traditional concern with supporting their political masters. This risks being extended into a perception that their real accountability is to the public and not to ministers.

2.6. DRT systems operation

The user makes a transportation request to the Travel Dispatch Center (TDC) in any of a given number of ways (phone call, SMS, email, web page, dedicated device, PDA, Tablet, for instance). At the TDC, the operator, or an automatic booking system, introduces the user-specified data, such as origin/destination and pickup/delivery times in the system. Depending on the DRT service type and the time the user contacts the operator, this data can be used, together with other user requests, to define routes and schedules for the vehicles before the service operating hours (static routing), or to change the on-going routes in real-time to accommodate the new request (dynamic routing). Then, the operator communicates the definitive schedule to the user (or rejects the request), who can cancel or accept the trip conditions (Ambrosino et al, 2003).

According to the user decision, the operator commits the necessary changes to the system. In static routing, before the service begins, the stored requests are used to define the routes and schedules for the operational horizon, whereas in dynamic routing the new routes and schedules are communicated to the affected vehicles in real-time. The vehicle makes the defined route, picking

up and dropping off passengers at the agreed points and times and, in the meantime, in a dynamic service, the operator is free to receive new requests and change routes accordingly (Gomes, 2013).

The importance of dynamic vehicle routing is increasing every due to, amongst other reasons, recent economic developments, where markets are ever more open and competitive. Logistic operators must comply with tighter and tighter deadlines not only to be competitive but even to survive. For that matter, the real-time availability of information such as vehicle position or traffic conditions is critical. Dynamic DRT systems use a number of technologies in an integrated manner. These technologies include Automatic Vehicle Location (AVL) systems, automated routing and scheduling, geospatial technologies, wireless communications, vehicle navigation, and e-card technology, just to name the most relevant (ibid).

2.7. Constraints of DRTS implementation

According to López (2010), the main obstacles for the implementation DRT systems are from juridical, institutional and organizational nature. The technical difficulties are less complex to deal with than the aforementioned obstacles because these obstacles are more dependent on political agendas and stakeholders' attitudes, perceptions and (sometimes conflicting) objectives.

For starters, the image of the services traditionally had a very institutional nature. The industry has been driven by the social inclusion agenda and features schemes that are complex, expensive, and custom-made and cost heavy (Enoch et al., 2004).

Another key difficulty originates from the DRT own nature and strength, in that it is a hybrid system. As a relatively new form of public transport, the juridical status of DRT has been unclear, with applications being slowed down by issues of how to register services successfully (Brake et al., 2006). This means that DRTs do not relate well to the regulatory structure that has been designed with conventional buses and taxis in mind. Shifting DRT to "legal" status would require the realignment of the overall public transport industry, its finances, and regulation.

The development of DRT systems should be based in the European Union, national and local transportation policies. Sometimes it might be necessary to change the national transportation policies to accommodate the DRT systems (Kisla et al., 2016). Nevertheless, the European experience shows that a DRT service is easier to implement in more regulated environments as

there is less conflict with other public transport modes (Brake et al. 2004) and subsidies are most likely to be available in regulated environments - whereas, in deregulated environments, subsidies are service specific.

Moreover, there are a variety of planning and implementation issues and DRT implementation problems are: high total costs; high dispatching costs; low revenue-to-cost ratio: the viability of DRT services as a self-supporting system has not yet been demonstrated, and the issues of fares and the cost of phone calls, subsidies, bus and control centre operation are tricky; low occupancy rates; peak demands and general consumer acceptance (Brake et al., 2006).

2.8. Service design of Demand Responsive Transportation System

2.8.1. Functional process

According to the 2002-2004 European Flexible Agency for Collective Demand Responsive Mobility Services (FAMS) project funded by EU-IST programme in coordination with ATAF (Public Transport Company of the Florence metropolitan area); business relations can be divided into two as (B2C) is targeting the customer/final user and (B2B) targeting the transportation operators (Ferrai, 2004). General descriptions of these relations are as follows:

"Business-to-Business (B2B) services, allowing interaction and teamwork among different transport service providers co-operating through the Agency.

Business-to-Consumer (B2C) services, supporting access to information and services for different associations, user groups, and communities" (Ferrai, 2004).

B2C services are about customers that can be different groups such as organizations, students, disabled or elderly people, etc. and transportation agencies where the software centre of transportation telematics system exists. Moreover, B2B relations are related to transportation providers and the software centre of telematics used to manage transport users data. Hence; the centre matches passengers' demand and transport source by B2B and B2C and defines a route accordingly.

Therefore, functional process of demand responsive transport system is made up of B2B and B2C relations. Keeping sources available, data management of transportation sources, vehicle allocation on need, route planning, drawing up a service list, and payment relations are B2B relations between the dispatch centre and service providers as well as between service providers themselves. Ticketing, reservation, service information, customer feedback are B2C relations between the passenger and the dispatch centre. Public transport authority as an administrative unit, controls demand responsive transportation operations management, supervision, payment collection, and vehicle communication management.

2.8.2. Influencing factors of service design

According to Enoch (2005), the demand for transport services is influenced by the features of the service area and by the service itself. The core aspects of the service area are the following:

i. **Geography and structure of settlements**: If the service area is in the suburb of a metropolis, it differs from the case when it is in the countryside with small villages that are far from each other.
ii. **Economic factors, industry and household incomes**: People with higher income have different demands; they require a higher level of service that people with lower earnings who probably do not have any alternative options to satisfy their mobility needs.
iii. **Demographic factors, Age and population density:** The latter is usually in connection with the structure of settlements. The number and the proportion of students, active workers, pensioners and physically challenged citizens to determine the volume of school, work, shopping, social and healthcare traffic, which have different characteristics and travellers have different demands and expectations of the service. These core factors of the service area determine the potential demand for the transport service.

2.8.3. Operational process

Designing the operation of a demand responsive transportation system is an important factor in setting the service quality. In order to have effective results, the topography of the target area, and the qualities and needs of the target population should be evaluated carefully. The suitable type of

vehicle with suitable carrying capacity is then determined and the operation is planned for the most efficient service. In the planning process; political factor, target group, human, vehicle, software, infrastructure sources, shareholders and co-operators, personnel-related issues, reservation details, information and marketing channels, tariff and ticketing channels should be taken into consideration (Nelson &Romanazzo, 2004).

A wide range of choices from a fixed route to a flexible one is present in service design. As the switch from the traditional public transportation system to the demand responsive transportation system requires radical changes where the most feasible design concept is a semi-flexible route system (ibid).

2.9. Economic framework of Demand Responsive Transportation System

Balancing income and expense, and ensuring that the income covers the expenses are important for sustainable demand responsive transportation systems. Passenger payments are calculated based on distance as the system has a dynamic route. It is important to be aware that since the passenger will conceive this system as a public transport, he should not want to pay a fortune; therefore demand responsive transportation systems as intermediate modes should be designed with a higher similarity to taxis in flexibility, yet with a higher similarity to busses in fares (Nelson &Romanazzo, 2004).

Expenses can be grouped as an administrative, investment and operational costs yet it would not be appropriate to distinguish them with strict lines as there can be common expenses within different areas. Since the service is provided dynamically based on demand, cost management is also flexible and optimization gains importance.

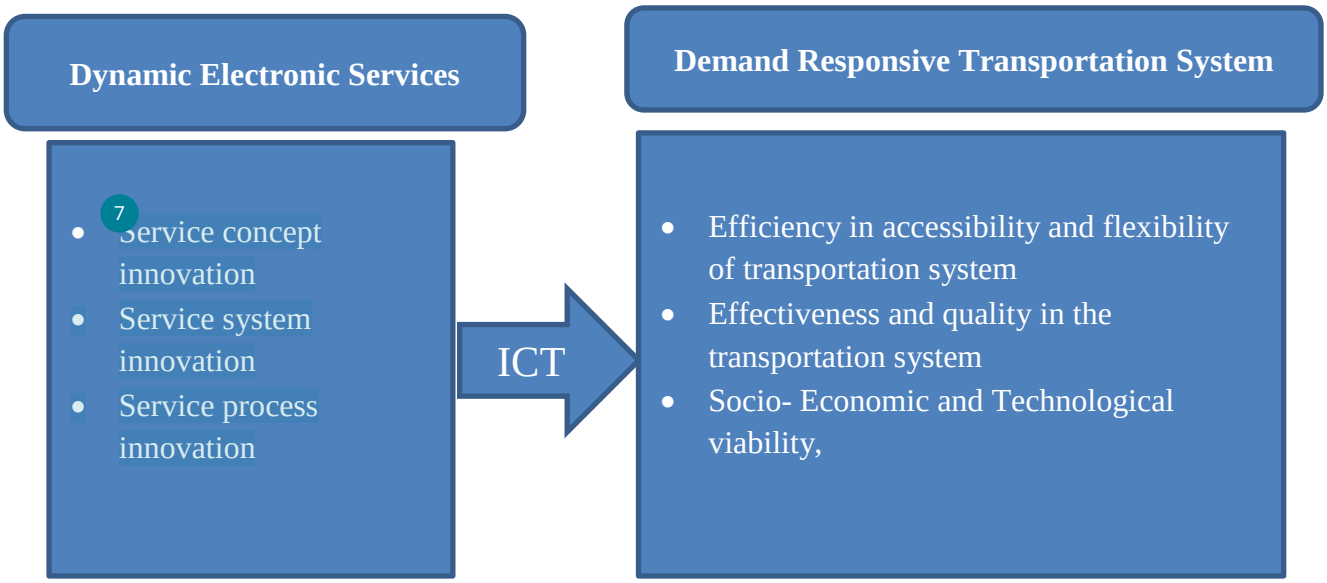
2.10. Conceptual Framework

Public transportation in this research is conceptualized as a means of transportation including buses and taxis which are used by the general public. Demand Responsive Transport (DRT) services provide transport "on demand" from passengers using fleets of vehicles scheduled to pick up and drop off people in accordance with their needs (Nelson and Romanazzo, 2004). Public DRT services are often fully or partially funded by authorities as providers of socially necessary transport. They are typically used to provide transportation in areas with low transportation

demand where a regular bus service might not be efficient. Another common application of DRT arises in door-to-door transportation of elderly or handicapped people (paratransit) and others. This research will adapt Nelson and Romanazzo's definition.

Based on this, this research adapted Essen and Conrick's (2008) model for developing new e-services using three types of innovation. This model is highly relevant to the various contexts ranging from an adaptation of new technologies to the highly innovative system. The detail discussion of the model has based on figure 2.

Figure 1: Conceptual Framework of the Study



Source: Adapted from Essen and Conrick's (2008)

Firstly, service concept innovation involves the assimilation of the new technology and service. It includes clarifying the service user (i.e. the type of the service), formulating benefits relevant and acceptable to this party. It also includes determining criteria for service eligibility. Secondly, service system innovation involves comprehension and adaptation. This means distinguishing between technical possibilities and benefits in the actual context. This includes defining the role of new technology and internal and external actors, the allocation of resources and authority to support these roles. Thirdly, service process innovation involves the implementation. It includes implementing the roles and configuring the technical system. It covers extending technology

executed tasks with human elements, creating routines for how personnel should act on technology-specific solutions and entails designing the customer's role.

This research relates the above concepts with the DRT system's performance in three conditions. The conditions are defined as follows.

i. Efficiency in accessibility and flexibility of transportation system can be defined in terms of concepts such as User-Accessibility, Demand Request, Flexibility, Approach, Time of operation, Coverage, Frequency, Travel time, Fare, Payment Options….etc.
ii. Effectiveness and quality transportation system are defined in terms of Providers-Profit, Communication, Quality, Legality and Data Analysis….etc.
iii. Socio-Economic and Technological viability includes concepts such as the utilization or feasibility of the use of technologies and the resulting impact on the social and economic lives of the city residents.

As shown in the above figure 2, the researcher argued that service innovation in terms of concepts, system, and process using ICT can result in a more efficient and effective public transportation service as well as socioeconomic and technological viability. It is assumed that the success of Demand Responsive Transport services is due, in part, to the availability of different dynamic and innovative electronic services which can radically improve the possibilities to provide an efficient and effective transport services in terms of interface with potential customers, optimization and assignment to meet travel requests, and service provision and management.

Chapter Three

Research methodology

3.1.Research Design

The study employed a descriptive research design. It also employed qualitative approaches to capture data for the purpose of better analysis and understanding of the contribution of ICT for the establishment and delivery of Demand Responsive Transportation Service in Addis Ababa. As discussed in the analytical framework of this research, it deals with how service concepts, system and process innovations in dynamic electronic service affect the transportation service. Thus, the most preferable approaches to capture the concepts and understand the interaction between ICT and transportation system is a qualitative approach. Based on this, descriptive research design and qualitative approach to capture data are used.

3.2.Types and Sources of Data

To achieve the objectives of this study, data was collected from Ethiopian key government officials (Directors and employees in the government structure) and private sectors in the transport sector through interviews and focus group discussion. In support of the primary source, secondary data sources on the experience of both developing and developed countries which have efficient public service delivery that contributes to the quality of government were dealt with.

3.3.Sampling techniques

The selection of key informants and interviewees were through purposive sampling techniques. Whilst purposive sampling is prone to research's bias, it allows to access specific characteristics in a targeted population group of interest (Palys, 2008). The nature of this research requires some expertise in both the transportation system and technologies. Based on this, the selection of private transport service provider institutions, government transport service providers' institution, city government officials, and directors both were interviewed.

3.4. Population and Sample size determination

The target population of this study is individuals and agencies that involve in the transportation business. This includes government agencies such as Addis Ababa City Government Transport Authority, public transport service provider institutions such as Anbessa city bus, Sheger mass transportation, private transportation service provider and taxi associations. Since there are various agencies (government offices) and private providers including the drivers that have a stake in the Addis Ababa transportation system, the total population for this research is not clearly defined. Thus, purposive sampling was used based on concept understanding, inclusiveness (to incorporate varied perspectives in the research), experience in the transportation sector, relevance and appropriateness of the respondents to the topic under this study.

In order to get an appropriate population, interview was done proportionally. Currently, as we have four private transport service provider institutions (ETTA, RIDE, PIC PICK, and ZYRIDE) three of them were picked through purposive sampling to get 75% representation. From government transport service provider institutions that is Anbessa city bus and Sheger mass transportation, out of 9 directors in total, 3 directors from both were picked through purposive sampling. As there are 3 Higher bus, 13 minibus, and 32-meter taxi associations, 30% i.e. 14 respondents from the total association were picked randomly to conduct an interview. And also interview was conducted out of 15 directors with 5. Focus group discussion was conducted with 5 managers of government transport service provider institutions (Addis Ababa transport authority), with 1 manager of private transport service providers. Generally, out of 82 representative population group, 30% was planned to be interviewed, i.e. 26 representatives. However, interviews were conducted with 22 respondents (85% response rate).

3.5. Data Collection Techniques

3.5.1. Primary Data Collection Techniques

Key informant interview and focus group discussion were used to collect relevant data from selected samples. The information gathered through KII was used to triangulate and complement the information collected through other methods. The data was gathered from private Demand

Responsive Transportation Service providers, concerned key government officials (Authority heads and Directors in the government structure), a face-to-face interview.

3.5.2. Secondary Data Collection Techniques

Secondary sources of data are gathered from different official documents, records, reports, archives and research findings of various scholars on the topic under this research. And also from the experience of both developing and developed countries which have efficient public service delivery that contributes to the quality of government in the efficient provision of demand-responsive public transport.

3.6. Data Presentation and Analysis methods

On this part of the paper, the role of Information Communication Technology (ICT) for the establishment and delivery of Demand Responsive Transportation Service (DRTS) in Addis Ababa city and to identify the major challenges of its implementation have been discussed taking the case of Addis Ababa City. Accordingly, the data collected through key informant interviews and focus group discussion with government officials (Authority heads, Directors and employees in the government structure) and private DRTS providers are presented and analysed. Transcribing the in-depth key informant interviews the focus group discussion has been the first action of the researcher in the data analysis phase. After transcription, the researcher has started labelling every theme of information based on the emphasis and importance given by the respondents. Finally, the labelled data were analysed to a nswer the research questions and address the objectives of the study.

3.7. Ethical Considerations

Throughout the study, the researcher has provided an appropriate focus on ethical issues. Everyone who has participated in the study has freely consented. Ethical standards have been applied to decisions made in planning and conducting the data collection process and for reporting of the results. There has been also no deliberate misrepresentation of the purpose of the study and overstatement or understatement of the findings.

Chapter Four

Data Presentation and Analysis

4.1. Introduction

As it has been explained in previous chapters of this research, the main purpose of this study was to collect detailed qualitative data on the role of dynamic electronic service for Demand Responsive Transportation System /DRT/ in Addis Ababa city Administration. To this effect, before the fieldwork was conducted, two categories of KIIs guides were prepared for Experts (Directors), Government Officials, and representatives of Taxi and bus Associations based on the objectives to be addressed and required information to be collected.

The interviews were designed in a more non-structured way, which allowed the participant to explain in an in-depth manner about the issue that they considered the most important. Prior to the interview, participants were kept informed about the objectives, significance of the study and how it can contribute to effective DRT implementation. Besides, the participants were encouraged to speak openly, thereby probing deep into the relevant issues. Each KIIs were recorded after obtaining the participants' consent and each recorded interview session took 25 minutes up to 47 minutes.

To be able to make sure that the data is valid and reliable, proper sources from stakeholders, managers, and experts with various levels of responsibility and background were selected, which includes ICT experts, concerned government officials, Public transport providers, representatives of Minibus and meter Taxi Associations and drivers and private DRT providers. Based on this, a total of 22 KIIs were conducted from March 26-April 3/2019 G.C. Thus, these key informants were purposefully selected based on their knowledge, proximity to the issue, experience, and willingness to participate in the study. The respondents profile is listed below.

Respondents' profile

No.	Code of KI	Position	Organisation	Date of interview
1.	0001/1	Coordinator and board member	Fikir minibus Taxi Asso.	March 26/2019 G.C
2.	0002/1	General Manager	Sheger Mass Transportation	March 26/2019 G.C
3.	0003/2	Public and Freight Transport Inspection Directorate	Transport Authority of AA city admi.	March 27/2019 G.C
4.	0004/2	General Manager	Transport Authority of AA city admi.	March 27/2019 G.C
5.	0005/2	Chairperson of Selam Taxi Ass.	Selam minibus Taxi Ass.	March 27/2019 G.C
6.	0006/3	Integrated Transport Information And System Research Director	Transport Authority of AA city admi.	March 28/2019 G.C
7	0007/3	ICT director	Anbessa City Bus	March 28/2019 G.C
8	0008/3	Transport Infrastructure Dev't & mag't Director	Transport Authority of AA city admi.	March 28/2019 G.C
9	0009/4	Deputy Manager	Transport Authority of AA city admi.	March 29/2019 G.C
10	00010/4	Chairperson of Nigat Higer bus Taxi Asso.	Nigat Higer bus Taxi Asso.	March 29/2019 G.C
11	00011/4	Inspection Team Leader of Fikir Taxi Asso.	Fikir Taxi minibus Ass.	March 29/2019 G.C
12	00012/5	Chairperson of Blen Taxi Asso.	Belen minibus Taxi Ass.	March 30/2019 G.C
13	00013/5	ICT Director	Sheger Mass Transportation	March 30/2019 G.C
14	00014/6	Chairperson Beruh Tesefa Taxi Asso.	Beruh Tefesa minibus Taxi Asso	April 1/2019 G.C
15	00015/6	Representative	Awuramba Meter Association	April 1/2019 G.C
16	00016/6	Chairperson	Yeken Meter Taxi Association	April 1/2019 G.C
17	00017/7	Representative	Bole Airport and hotels Taxi Share comp.	April 2/2019 G.C

18	00018/7	Representative	Z Lucy Meter Taxi Association	April 2/2019 G.C
19	00019/7	Integrated public and cargo Trasportation	Transport Authority of AA city admi.	April 2/2019 G.C
20	00020/8	Chair person	Summit Taxi Asso	April 3/2019 G.C
21	00021/8	Chairperson	Meseha Meter Taxi Association	April 3/2019 G.C
22	00022/8	Manager	ETTA taxi (Private DRTS provider)	April 3/2019 G.C

Therefore, based on the methodology stated in chapter 3, major findings and analysis on DRT I Addis Ababa City Government is stated as follows.

4.2. The Transportation System in Addis Ababa

Interviews with study participants clearly indicate that the current transportation service in Addis Ababa city administration does not fully satisfy the needs of the public in terms of quality accessible and affordability. Government officials also explain that in spite of the efforts made by Addis Ababa Transport Authority and the Federal Government in formulating, implementing measures, policies, strategies, and programs to develop an adequate, safe, secure and affordable transport system, a wide gap still exists between planned targets and the level of achievement.

This can be attributed to the numerous challenges and constraints that the city administration faces in relation to the development of sustainable transport systems. According to authorities, the expansion of the city, increasing population size coupled with socio-economic development has posed numerous challenges. The major challenges and constraints mentioned by study participants include:

- **Poor infrastructure:** The road space in most parts of the city is insufficient. Most of major roads and junction in Addis Ababa are crowded with parking vehicles, street vendors and street dwellers. As a result, the roads for moving vehicles become much narrower.

- **Vehicular growth:** vehicle registration indicates that the rates of vehicles are mounting every year. According to information gained from Addis Ababa transport authority, Ethiopia imported more than 20,000 cars every year. This will result in acute congestion and delays, serious accidents, high-energy consumption
- **Parking difficulties:** Roadside and unlawful parking are common features in Addis Ababa. Traffic crowding due to inefficient road space, poor road maintenance, illegal parking and street vending
- Inadequate or non-existent traffic signals and lack of traffic management
- The excessive intervention of government in the public transport system
- The limited capacity of the sector could not satisfy the mobility needs of the city. Absence of terminals on the origins and destinations of the minibus taxis and of the minibuses.

In relation with this issue, 0002/1 explained that:

> *The existing transportation system is not sufficient for efficient transportation service in the city. This is perhaps mainly associated with lack of integration. We need integration among institutions, different levels of government, and different transport modes and operators. In most cases when they are performed in isolation, it results in conflicts in decision-making and implementation of planned activities. Therefore, one major challenge for ineffective transportation in Addis Ababa is lack of organizational integration. (0002/1, personal communication, 26/03/2019)*

In the eyes of most respondents, poor infrastructure, poor condition of road vehicles, inadequate management of transport businesses, out-dated technology, and lack of integration are the main causes for the continuing low quality of service. Thus, these problems are closely inter-related and contributed a lot to the inadequate quality of transport service, poor safety, poor accessibility, and affordability.

4.3. Type of DRT System and Frequency of Usage in Addis Ababa

The information gained from Transport Authority officials revealed that various transport modes such as buses, taxi s, mini-buses, and midi-buses usually have been undertaken several

DRT services. In many instances, ambulance vehicles, city tour buses are parts of existing demand responsive public transportation services.

According to Information gained from Transport Authority of Addis Ababa City Government, there are 32 taxi associations that are involved in providing demand responsive transport system in one way or the other. Moreover, the city imported 1,663 yellow taxis to modernize the transportation system and to DRT service in the city. For instance, currently taxies like ZyRide Taxies, "Pick Pick" and ETTA are providing demand responsive transportation and operate with the existing system. The total information concerning the three private DRTS providers is summarizes below.

DRT user's and operation characteristics.

Table 2: DRT User's and operation characteristics

No.	Name of DRTS provider	In operation since	Total Trips	Sex		Total number of cars used	Request platform	
				Male	Female		Application	Call center
1	ZyRide	July 2016	1,095,000	41%	59%	1,080	30%	70%
2	ETTA	July 2016	237,473	46%	54%	220	35%	65%
3	Pick Pick	Dec 2018	37,616	35%	65%	300	10%	90%
Total			1,370,089	41%	59%	1,600	25%	75%

Source: Private DRT service providers' data base (2019)

As indicated in the above table from the two years' experience of private demand responsive transport providers, among the users of the service 59% are female while 41% are male. This shows that female users are more in proportion. The total number of trips during their operation is 1,370,089. If we consider the average service year to be two years and half i.e. 913 days, on average per day they make 1,500 tips. When we compare it with the total trip in all public transport which is 2,805,842 trips per day to transport 2.6 million passengers on daily basis (Addis Ababa Transport Authority, 2018), we can clearly see that DRTS which uses request platform is at an infant stage. In addition, in the request platform, the use of call center is the highest (75%).

Whereas application utilisation for the request is very low (25%). In addition the total number of cars that are being utilised for private DRTS is 1,600. When we compare it with the average total public transport available on daily basis i.e. 10,631 (Addis Ababa Transport Authority, 2018) which is still very low.

Table 3: Frequency of DRT Usage

No. Client's used DRT	Frequency	No. of user
User range	1-5	4535
User range	6-10	224
User range	11-15	86
User range	16-20	61
User range	21-25	37
User range	26-30	31
User range	31-40	36
User range	41-50	28
User range	51-60	17
User range	61-70	13
User range	71-80	7
User range	81-90	6
User range	91-100	3
User range	101-200	23
User range	201-300	5
User range	301-400	0
User range	401-500	1

Source: Private DRT service provider data base (2019)

With respect to frequency of DRT usage as indicated in the above table, the number of individuals who use the service from 1 to 5 times within two years is the highest. In this range, 4535 customers were served. Concerning the frequency, there is one user which falls under the category of 401 to 500.

4.4. ICT's Impact on DRT

Regarding the impact of technologies on the service and quality of DRT, participants of this study believe that ICT can optimize and improve transport by making DRT service better

organized and effective. For example, a passenger waiting at a bus stop scheduled for a certain time and the bus being delayed, because there is no way of communication between the passenger and the bus service provider. These passenger may wait for a very long time, but if there was a way of communicating to the passengers through application, they would have decided on other means of travelling and saved time.

In the same manner, 0007/3 clearly elucidates the effect of ICT in DRT transport service as follows:

> *The uses of GIS, as well as mobile applications make it possible to track, locate and share the location of a vehicle amongst the drivers, the customers, and the companies. Therefore, ICT technology might be able to give us a better solution for providing a certain level of high-quality DRT services by making transport systems affordable, simpler and easier to utilize. The technology-based transport system also uses e-ticketing; it uses smart cards for fare payments. This enhanced integrated fare System has resulted in the improvement of public transport for both bus drivers and passengers, as passengers do not have to waste time calculating fares, and disturbing the bus driver to get their change back, therefore the drivers focus fully on driving. Cognizant of the fact, we are developing various sorts of software and a central database. (*0007/3, *personal communication, March 28/2019)*

Hence, from this explanation and data obtained from the private DRT service providers, we can understand that technology advancement can contribute to safety, convenience, reliability, and quality of transport service. Moreover, it shows that the number of users of DRT is increasing, which shows the gap that is currently filled by the infant system. In general, standardization of technology application can improve the coordination and operations of DRT service as well as Mass transport in general.

4.4.1. *DRT service concept innovation:*

An important concept in DRT services is the booking of the trip. This important concept is being exercised in our country over the last three years. Its practical implementation can be seen in the figure3, three phases can be distinguished in the booking process: 1) a customer request for a trip,

with a particular origin and destination (stop or address) and arrival or departure times; 2) the proposal of a feasible service by the service operator; and 3) the booking confirmation (or refusal of the proposed service) by the customer.

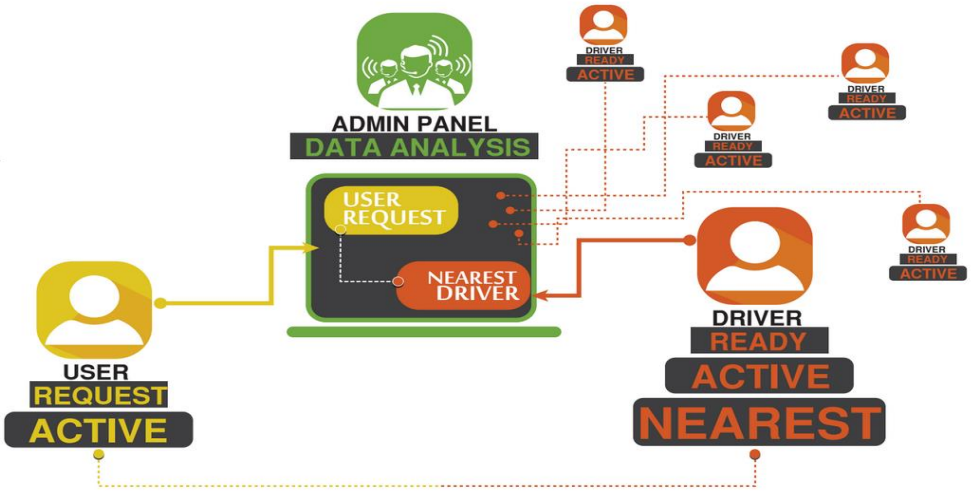
However, telematics technology is one of the technologies of Demand Responsive Transportation System which is a combination of automobile and transportation industries with information and communication technologies. Vehicles equipped with telematics technology have two-way communication systems, GPS tracking systems, and a control for the electronic system of the vehicle accessible by the driver and/or passenger switching from the fixed route system of the traditional public transport to the demand responsive route flexibility of demand responsive transportation service requires technological adjustments such as route listing and allocating, and passenger to vehicle matching (Kisla et.al, 2016).

The suitable transportation telematics for this need can be examined in two categories: Travel Dispatch Centre (TDC) and Automatic Vehicle Location (AVL). Travel dispatch centres responsibilities include planning voyages, allocating vehicles, planning voyage durations, demand management, and service follow-ups. Passengers contact the travel dispatch centre to request reservations, to cancel a request, to demand a travel notice and to ask for service-related information. In order to provide this communication between the dispatch centre and passenger: web-based (online) services, smart phones, and Interactive Voice Response System (IVRS) vehicles are suitable (ibid).

AVL systems provide communication between the vehicle and the dispatch centre. Moreover, a location system that receives and tracks location data through a communication network between units mounted in the vehicles and the units in the dispatch centre is installed. Evaluating GPS and GIS data, VMS, receiving dynamic information through mobile apps is the most dynamic and practical method for location systems compared to other alternatives. Due to all these reasons; improving the systems to become more dynamic and to provide a faster data recollection, to inform the drivers as quickly as possible and to collect information from the mobile vehicles and infrastructure data are the targets today. Rapidly developing computers and wireless communication devices provide for meeting these demands.

A fast and dynamic communication network is established between the passenger and the travel dispatch centre through transportation telematics technology devices and demand is received. Simultaneously, the live location tracking feed from the vehicles is crossed with the demands and the most convenient vehicle to the passenger's location is allocated to meet the demand. The most practical payment method for the passengers would be using contactless smart cards at the units within vehicle integrated into all transport modes or web or mobile network-based credit cards (Kisla et.al, 2016).

Figure 2: Simple DRT service Operation



Source: Private DRT service provider data base (2019)

The booking workflow can be implemented in a number of different technologies. In the first implementations of these systems, a human dispatcher was often involved as a direct interface between the customers and the booking component. Nowadays, technology systems, such as Interactive Voice Response (IVR) systems, Internet and Web Services, mobile phones and SMS, just to name a few, allow a higher degree of automation of the booking process. An IVR is a computer system that allows the user to select an option from a predefined menu, using the telephone keypad. More sophisticated IVR systems integrate speech recognition so that the users can select options from the menu using their own voice (Gomes, 2013 and Ambrosino et al, 2003).

In a transportation context, IVR systems and Smartphone applications allow users to schedule trips, check scheduled ride times, confirm services, and cancel trips, in an entirely automated and

pervasive way which does not require interaction with human operators. Smartphones add the possibility of graphical feedback and more features such as map and route visualization.

As found out from the private DRT service providers, because of insufficient ICT infrastructure, they use call center to replace the internet based system. Although, IVR and Smartphones do allow a higher degree of automation of the booking process, but in most cases the target users of the DRT service in Addis Ababa might not be prepared for new information technologies, thus relay on the phone call. This is also supported by Ambrosino et al., (2003) as they argue to integrate the 'old phone call' in the system to accommodate the demand of those who cannot access the system from web based applications.

4.4.2. Service System Innovation:

ICT Effect on the Quality, Accessibility and Efficiency of Demand Responsive Public Transport System

According to the information gained from the study, participants shows that ICT has an enormous effect in quality, accessibility and efficiency of demand responsive transportation system. On the one hand, ICTs can be used in transport in order to enhance and advance Demand Responsive transport operations. On the other hand, ICT infrastructure enables reliable communication between vehicles, customers and an institutional traffic management system.

According to, 0006/3, Addis Ababa transport Authority Information system and Study Directorate Director, ICT applications in the transport system in general and DRT service, in particular, has major benefits for improving the coordinating and integrated transportation system as well as transport management. He also indicated that ICT could improve communication regulator systems and trustworthy electronic payment services. In addition, currently different ICT initiatives are being exercised. For instance,

Informants also mentioned that ICT could reduce traffic accidents, congestion and crowdedness by offering integrated clear, brief and timely information about service rendered in the transport sector. Furthermore, most respondents stated that ICT could play a paramount

role especially in establishing DRT service and enhancing a safe, reliable and accessible transport system.

Socio-Economic and Technological Viability to Establishment of ICT based Demand Responsive Transport Service

In relation to the level of utilization ICT, the entire research participants expressed in one way or another that the level of ICT utilization in the transportation sector in Addis Ababa is at the infant stage. Based on information gathered, there is currently minimal use of ICTs in the public transportation system in the Addis Ababa city Administration. System innovation using ICT such as pooling system and dispatch network can be useful in improving efficiency of transport infrastructure and met the increasing demand, hence improving the effectiveness of the system. This is to say that, rather than simply dispatching transport means based on prior-schedule, dispatching based on the actual demand helps in lowering the cost of running the service without affecting the demand.

Respondents mentioned that there is some sort of initiations using ICT in certain mass transportation buses and Meter taxies. However, even these transport service sectors are not fully implemented ICT based Transport services. Informants from both government offices and Taxi Associations believed that using ICT in transportation is not a choice, but it is a necessity. The relevance of ICT in the public transportation system is not questionable looking at how it has transformed other cities and countries public transportation systems. In addition, the accessibility of information and convenience were indicated as the main reasons for ICT relevance.

Nevertheless, the viability of ICT in Addis Ababa city administration remains challenging due to lack of basic infrastructure, shortage of ICT skill, inadequate institutional arrangement, inadequate horizontal and vertical communication, lack of reliable supply of electric power, telecommunications, and poor institutional capacity. Respondents also explained that a significant number of cars operating in the city administration still includes many obsolete cars, which adversely affects the application of ICT technology. Most of the buses and minibus taxis are just vehicles with basic technologies only for mechanical operation. These out-dated cars have no devices to use ICT technologies such as global positioning system (GPS), communication, Kilometres Gage and other required devices.

On the other hand, computer literacy, awareness of ICT devices and application will be a major constraint on the establishment and integration of ICT technology in the transportation system. Similarly, some respondents explained, that the indifferent attitude and of the public will also undermine wide-scale use of ICT technology.

In relation with this issue, 0001/1 stated his view as follows:

> *As far as I understand ICT based demand responsive transport service requires requesting for transportation services by a passenger or client using a phone, computer or application to the scheduling and responding by the operators and drivers using computers, online maps, and SMS, tracking and mapping technologies. Therefore, these technologies are expected to be user-friendly, which means it is better to modify and customize the applications in a way that easily applicable by both operates and clients to meet real needs, rather than imaginary or estimated ones. For instance, it is preferable if most of these technology applications are translated into the language that I understand well. (*0001/1, *personal communication, March 26/2019)*

Similarly, study participants suggested that a positive attitude on the part of the customers is a precondition for the successful implementation of ICT based DRT service. They also mention that basic technologies such as phone calls, SMS, and other costs of the service should be affordable and usable by the majority of the people.

4.4.3. Service Process Innovation

The Sufficiency and Suitability of the Existing Policy and Business Environment for ICT Based DRT

According to respondent 0004/2, the transport policy of city Administration aspire to provide safe, efficient, comfortable, affordable, reliable and accessible transport service for the urban dwellers. The respondent also added that this policy sets the foundations for a renewed public transport system and the improvement of technology-based transport practices through the introduction of Intelligent Transportation Systems (ITS). In addition, the new policy framework has been articulated with the master plan for urban development (2010-2015) of the city, because the transport system of the city is integrated with various institutions. Hence,

the transport policy of the city administration has laid the favourable ground for implementation of ICT based demand responsive transportation system.

Moreover, 0009/4 clearly explained the intended goal of the transport policy in the following manner:

> *Based on the policy direction of the Transport Authority of the city administration we are striving to enhance the status of the city as a national and international seat, by introducing efficient and technology-based transport service. To this end, we have organized ICT Directorate independently to enhance implementation of ICT technology in the transport system. Thus, currently we are working hard to advance the application of technologies, Capacitate the principal stakeholders in their institutional structures, develop qualified human resources, and advanced skills in information dissemination and research in the field of urban transport. The transport policy of the city administration also encourages private sector participation to enhance safety and effective transport services. Moreover, Business agencies and associations are encouraged to invest and play their role in advancing technology-based transport system. Therefore, anyone can certainly recognize that the policy direction of the city administration is quite suitable to establish ICT based Demand responsive transport system (*0009/4, personal communication, *March 29/2019).*

To the contrary, representatives from Taxi Associations (0001/1) and manager of private demand responsive transport provider institution (00022/8) argue that the city administration has no clearly defined legal, institutional and policy framework. They complain that, the transport sector of the city administration is not fully exercising their responsibility and mandates. When the transport policy of Addis Ababa City Government which is ratified in 2011 is check, it does not clearly indicate how private DRTS providers can be encouraged and how ICT implementation in the system is exercised. Over the years, the government through the Transport Authority and municipality office have introduced policies and strategies to improve transportation system. However, most of these policies, regulations and action plans are not only comprehensive but also have not been implemented fully.

They also argue that, although the transport system requires institutional integration, like the integration of information and services and infrastructure, the sector is loosely organized. Moreover, there is no clear intuitional integration between public transport systems, different modes, and operators; and with other transport systems.

This lack of collective responsibility makes enforcement measures against associations and drivers in particular somewhat ineffective. Therefore, it is suggested that DRT services have to be integrated institutionally, which means that a legal basis between the public transport operator and the public transport authority has to be established which also includes payment or reimbursement rules, safety, and security and so on.

Nonetheless, it is found that currently the Addis Ababa City Administration, Transport Bureau is introducing a framework to support the immerging DRT service providers. For instance, the mechanism for the registration and licensing of DRT service providers by the Trade and Industry Bureau is not clear. However, currently there is a team of experts from various offices working on this major bottleneck.

4.5. The Opportunities and Challenges of DRT System in Addis Ababa

As per the information gathered through the interview, when the challenges and opportunities are assessed for the establishment of DRT in Addis Ababa, it could be quite challenging task to have or establish efficient DRT system within the current capacity of infrastructure, manpower, traffic management, technological capacity, and attitude of society, quality of vehicle and other related factors of the city. On the other hand, as opposed to what has been stated by informants, the Transport Authority argue that though there are numerous things to be improved to establish efficient DRT service in Addis Ababa, DRT is already part of an urban transport system. In addition, the stated that it is widely believed that this mode of transportation will better serve the needs of the population, to capture additional travel demands together with other transportation modes.

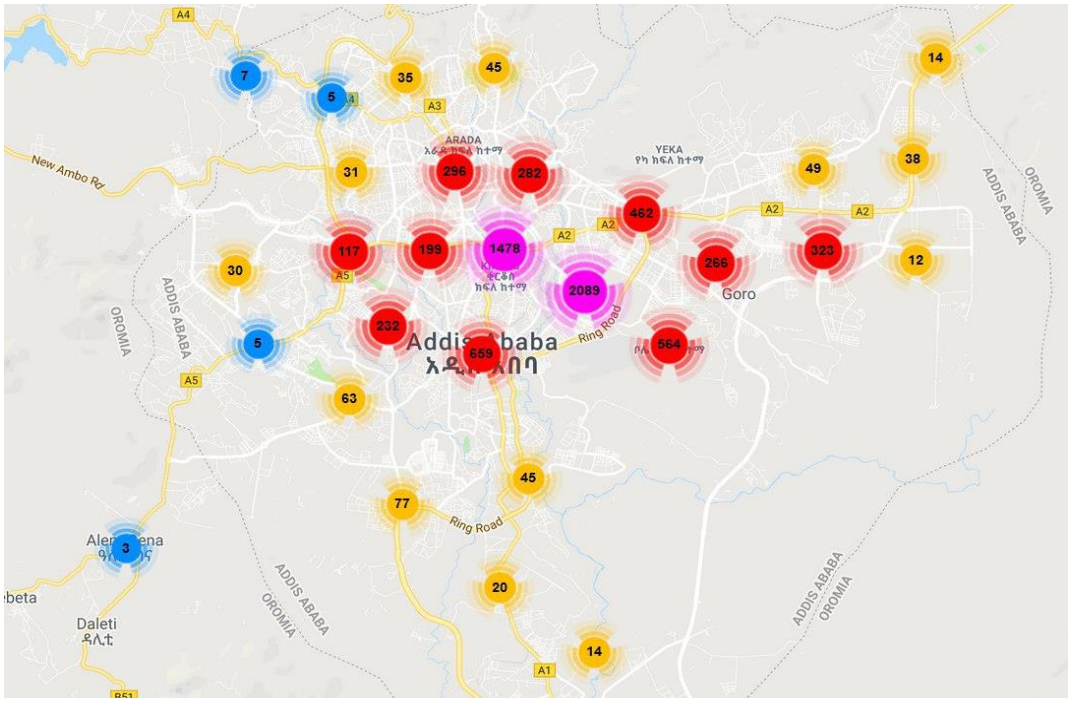
The booming demand for DRT from the customer side (please see table 2 and 3) can be seen as an encouraging opportunity for the private DRT service providers. Similarly, the government's commitment at the federal and city government to enhance the service to the next higher level

using ICT, which is expressed in terms of infrastructure expansion, policy revision, strengthening of rules and regulation in support of ICT based business as well as PPT policy framework, is another important opportunity to strengthen the DRT System.

Likewise, 0004/2, explains that though the prime focus of the city administration is mass transportation, authorities are expected to look alternative transport services to accommodate the growing demand of Service. The respondent also mentioned that "we are supposed to go long way to deliver efficient DRT service, but this doesn't mean that it is utterly impossible to establish this mode of transportation in the city administration if those issues related with infrastructure and institutional capacity are improved". But some informants from Transport Authority mention DRT is already part of the City transport system. Therefore, this mode of transportation could be one alternative system that complements the current urban transport in an efficient manner and enhance service quality and can play a particular role in minimizing challenges in transport services by providing significant alternative transport service, which accommodates a growing transport service demand of the city Administration.

Moreover, it is suggested by Transport Authority officials that Demand-responsive transport can play an important role in peripheral areas of the city Administration where public transport connectivity is not well developed, and where running full-scale public transport may be absurdly inaccessible. However, according to the interview conducted and from the primary data gathered from DRT provider, the service users are highly concentrated in the inner part of the city (see figure 4).

Figure 3: Concentration of Services



Note: stands for very high demand area, stands for high demand area

Stands for medium demand area, stands for low demand area

Source: Private DRT service provider (2019)

Note: the numbers in the circle shows the number of DRT service requests.

In relation to this issue, 00017/7 clearly explained the advantage of DRT as follows:

> *I believe that DRT can serve as an alternative transport system. However, I strongly suggest that the city administration should work hard to create an enabling environment to establish efficient DRT service. Above all things infrastructure, innovative technologies, and a traffic management system should be improved. If the aforementioned things are well addressed DRT have potentially great ability to complement the quality and access of transport service.*
>
> *For instance, demand Responsive public transportation vehicles would pick up and drop users exactly where they need to be dropped or picked. This also applies to users who wait very long times for buses and taxis without knowing when they are coming. With demand responsive public transportation, the person waiting will know when they*

*will be picked up, this gives passengers a sense of assurance and trust in the public transportation system. Moreover, in areas where the current public transportation vehicles are easily inaccessible DRT is a suitable solution. (*00017/7*, personal communication, April 2, 2019)*

Similarly, 00021/8 explains his view in the following manner:

The existing transport system cannot allow the establishment of DRT service. Even those involved in this business are suffering a lot because of the poor traffic management system, inefficient administration and high cost of spare parts. Sometimes I have forced to serve only one customer from mooring up lunchtime due to traffic congestion.

*The other worth mentioned problem is there is no domestic supplier of spare parties. If such constraints are solved, DRT can play a significant role in the transport system of the city administration since the usual mass transport services are not always enough to satisfy the demand of all customers. (*00021/8*, personal communication, April 3/2019)*

In general, all participants agreed that the existing transport system is not sufficient to accommodate large scale DRT service. Hence, it is suggested that the city administration should improve the required transport system, which includes, infrastructure, traffic management, and integrated coordination, technological and institutional capacity by taking in to account the role of DRT in complementing the growing demand of urban transport services.

4.6. The Major Constraints to use ICT in Improving Public Transport System

In light of this, the research participants explained that since ICT based DRT service require the application of sophisticated and efficient technologies there are a number of factors that hinder to use ICT in improving Public Transport System. The high cost of ICT infrastructure and non-availability of skilled human capital, employee education levels, in particular in relation to ICT skills, network coverage, and public awareness are major challenges mentioned by study participants. Moreover, useful Potential applications of science and technology, advanced software, materials, tools, and expertise are not easily available for ICT

development. Operation and maintenance skill of ICT in the transport system are also mentioned as constraints in the process of ICT implementation.

Regarding this issue, 00013/5, elaborate the major challenge to use ICT in improving the public transport system as follows:

> *In my view, the major challenges that can hinder the use of ICT in improving mass transportation are mainly associated with poor telecommunication infrastructure and limited literacy on ICT science. Besides, high costs of ICT equipment, legal and regulatory issues, excessive reliance on foreign technology, weaknesses in ICT implementation and poor understanding of the dynamics of the knowledge of electronic equipment can hamper the effectiveness of ICT use in transport. The other major challenge, which even makes worse the use of ICT in the transport system in Addis Ababa, is power fluctuation. Obviously, there is no sufficient and reliable power supply in the city administration to use such a power demanding technology. (00013/5, personal communication, March 30/ 2019)*

In general, informants repeatedly mentioned that poor infrastructure, poor internet coverage, weak institutional support and level of security are the factors that affect both efficiency and quality of ICT use in improving public transport in general and DRT in particular.

According to information gathered, the major constraints likely to be faced in ICT usage in DRT include:

- Poor infrastructure and network or internet coverage
- Inadequate institutional support
- Lack of skill and competence to install, maintain and fully operate technology based transport system
- High costs of ICT equipment
- Inadequate legal and regulatory issues
- Excessive reliance on foreign technology and weak technology drafting skill
- Power fluctuation.
- ICT awareness and literacy among transportation users

- Poor understanding of the dynamics of the knowledge
- Resistance to change and adaptation by stakeholders (drivers, government officials, owners, users) may be faced.
- Lack of political commitment and sectorial cooperation.

Challenges are likely to be encountered at different stages of the integration process, as the transportation system is government controlled but run by private companies and individuals.

Chapter Five

Conclusions and Recommendations

5.1. Conclusion

The major themes of the study were reviewing the existing status of the transport system in Addis Ababa City Administration, challenges realized in delivering quality, accessible and affordable transport service. Overall, the research looked into how ICT contributes to service quality by strengthening the DRT system. Using the framework adapted from Essen and Conrick's (2008) model for developing service using three types of innovation, it assessed the current transportation system and identified the major challenges. Under this framework, the role of effective and efficient policy, institutional and legal framework for the implementation of ICT based demand responsive transportation services were assessed. Besides, major implementation constraints to implement ICT in the establishment process of demand responsive transportation system were reviewed.

During the research, detailed qualitative data on the role of dynamic electronic service in establishing demand Responsive Transportation System /DRT/ in Addis Ababa city Administration were collected. This includes assessing the status and capacity of transport system of the city to accommodate the growing demand for efficient transportation service, the current available systems and capacity of the Addis Ababa city Administration to establish ICT based demand responsive system, level of utilization of ICT to improve the efficiency, effectiveness and quality in public transportation service in Addis Ababa. To this end, the data were collected through key informant interview, focus group discussion and gathered from different official documents and records.

The findings of this study revealed that the existing status of the transport system in Addis Ababa city Administration is not sufficient to accommodate the growing demand for transport service. The transportation systems, as well as overall infrastructural capacities in the city, are demanding additional efforts and investments to provide quality, accessible and affordable transportation. It is also apparently highlighted that, establishing ICT based DRT transportation service could be one alternative system that complements the current urban transport service

and can play a particular role in providing integrated, inclusive and flexible transportation. However, it is clearly indicated that it could be hardly possible to fully implement technology-based transport system with the current infrastructure and technological capacity.

Finally, this study shows the major constraints in ICT usage which includes poor infrastructure, poor network or internet coverage, lack of ICT awareness and literacy, resistance to change and adaptation by stakeholders, lack of political commitment, inadequate institutional arrangements. Therefore, in order to be able to realize quality service provision in the city transport system, demand responsive transport (DRT) could a better solution if the required preconditions are fulfilled.

5.2. Recommendation

As per the findings in the research the following recommendations are drawn based on the research analytical framework to be able to enhance the quality and access of transportation service through demand response transport in Addis Ababa.

5.2.1. Service Concept innovation

- With all possible alternatives enhance the performance and governance of the urban transport system using technology
- Expansion of mass transportation supported by DRT innovation
- It is necessary to upgrade the ICT infrastructure in the city administration, as the existing infrastructure has no ability to support most technologies. Even though some ICT applications can work with the current infrastructure, it needs to be expanded to support other technologies and for efficiency.
- ICT applications should be made available to all people in different languages so that people can all understand how to use the ICT based transport system.
- Ticketing and fare payment technologies and applications such as smart cards, electronic payment systems, and mobile payment applications should be established for convenience and safety.

- Tracking and monitoring technologies integrated cameras, GPS, CCTV surveillance and AVL technologies are expected to be connected in order to monitor activities in the vehicles, monitor driver behavior, vehicle speed, routes, bus stations, and bus stops
- Mobile applications, websites, and variable message signs would be promoted to provide relevant information to passengers. The technologies used by ICT based DRT services such as social networks, free call centers, SMS and USSD should be easy to use and accessible.

5.2.2. Service system innovation

- Enhance the capacity of urban transport planning and management and each transport policies need to be pursued in the context of a well-balanced urban transport strategy
- Constructions and major developments in the city shall be required to integrate the provision of adequate and up to standard parking facility
- Sector coordination should be improved within the transport sector itself and with other sectors of the City Government
- Subsidize public transport, allow importing of duty-free spare parts for individuals and associations who intended to provide alternative or Demand responsive service.
- The inclusion of all stakeholders in all tasks should be considered in order to realize effective and efficient ICT based DRT service.

5.2.3. Service Process System

- The government should address the needs of a diversified modal choice set of transport service which will give an opportunity to expand demand responsive transport system
- Competition in transport services through engaging the private sector massively and through public-private partnership where the demand is already existent
- Establish national government policy and incentives for integrating urban transport
- The efficiency of transport operation should improve.
- Education and awareness of ICT based transport system should be promoted
- Skills needed to install electronic devices, skills to maintain them during operation, skills for drivers and other personnel to operate these devices after installation.

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Appendix

Interview Questions for respective experts, government managers and officials

Concept innovation

1. With the current available systems and capacity of the Addis Ababa city Administration, is it possible to establish demand responsive transport system?
2. If your answer to the above question is yes, how do you think ICT affect the establishment of demand responsive transportation system?
3. If your answer to question no. 1 is no, could you please explain why?
4. If your answer to question no. 1 is yes, how do you think ICT affect quality and access to efficient public transport?
5. If your answer to question no. 1 is no, could you please explain why?
6. Do you think ICT can be used to improve the mass public transport system?
7. What do you think would be the major challenge to use ICT in improving the mass public transport system?

System innovation

1. What are the existing institutional frameworks (defined as systems and enabling environment) for the implementation of ICT based demand responsive transportation system?
2. What are the existing policy frameworks for the implementation of ICT based demand responsive transportation system?
3. Do you think the existing policies are sufficient to accommodate the growing demand for efficient transportation service? If not, what do you suggest?
4. What are the legal frame works that needs to be introduced to efficiently implement technology based demand responsive transportation system?
5. Do you think there is a suitable business environment for the effective implementation and utilization of ICT to establish demand responsive system?

Service innovation

1. What type of DRT system exists in Addis Ababa?

2. What types of technologies to use to establish demand responsive transportation system for the society?
    a. Technology concepts
    b. Technology systems
    c. Technology process
3. How do you think these technologies impact the establishment of demand responsive transportation system?
4. Do you think those technologies can be used in improving the quality of service provision of the mass public transport system?
5. If yes, how?

Efficiency and effectiveness in accessibility, flexibility and quality of transportation system

1. Do you think the existing transportation system is sufficient to accommodate the growing demand for efficient transportation service?
2. If your answer to question no.1 is yes, could you explain your answer?
3. If your answer to question no.1 is no, what do you think is the causes of inefficiency in the transportation system?
4. What can be done to improve the quality and access to efficient transportation service in Addis Ababa?

5. What are the major challenges in establishing a quality, accessible and affordable transportation system in Addis Ababa?

6. Do you think demand responsive transportation system can be one of the solution to the existing challenges in the transportation service?
7. Could you please explain your answer for question no. 6 in a detailed manner?
8. How do you evaluate the acceptance and level of utilization of ICT by the government in improving the transportation service?

Socio- Economic and Technological viability

1. Who are the major users of ICT based demand responsive transport service?
2. Could you please explain the most common characteristics of those users in terms of most frequent travel time, travel behavior, most preferred payment method, movement pattern and so on?
3. If successfully implemented, do you think residents will be able to use ICT effectively? If yes, why, and if no, why not?
4. How do you explain the level of ICT utilization in the transportation sector? (hint: High utilization of ICT can be understood as most services in the transportation sector are provided using technologies, few to none manual based service)
5. What are the major factors that affect utilization of ICT in the transportation system?
6. What could be the major implementation constraints to implement the technologies in the establishment process of demand responsive transportation system?
7. What do you recommend in order to tackle those constraints?

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